What is claimed is:

1. A plasma processing system for processing a substrate, comprising:

a process chamber within which a plasma is both ignited and sustained for said processing, said process chamber having an upper end and a lower end;

an electrode disposed at said lower end of said process chamber, said electrode being configured for generating an electric field inside said process chamber; and

a component for controlling an impedance between said electrode and said plasma, said impedance being arranged to affect said electric field to improve processing uniformity across the surface of said substrate.

2. The plasma processing system as recited in claim 1 wherein said impedance is configured to reduce variations in said electric field.

3. The plasma processing system as recited in claim 1 wherein said impedance is configured to produce variations in said electric field.

4. The plasma processing system as recited in claim 1 wherein said electric field produces a sheath voltage between the surface of said substrate and said plasma when said substrate is disposed inside said process chamber for processing.

5. The plasma processing system as recited in claim 1 further including an edge ring disposed above said electrode arrangement, said component being disposed between said edge ring and said electrode arrangement.

6. The plasma processing system as recited in claim 1 wherein said component is arranged to control said impedance between said electrode and said plasma at the edge of said substrate.

7. The plasma processing system as recited in claim 6 wherein said component has a portion that is disposed between said substrate and said electrode when said substrate is disposed inside said process chamber for processing

8. A plasma processing system for processing a substrate comprising:

a process chamber within which a plasma is both ignited and sustained for processing;

an electrode disposed inside said process chamber, said electrode being configured for generating an electric field between said plasma and said electrode;

a chuck disposed above said electrode, said chuck being configured for holding said substrate during processing, said electrical field having a first impedance between said electrode and said plasma in the region of said chuck;

an edge ring disposed above said electrode and adjacent to said chuck, said edge ring being configured for shielding at least said electrode from said plasma;

an impedance matching layer disposed between said edge ring and said electrode, said impedance matching layer being configured for controlling a second impedance between said electrode and said plasma in the region of said edge ring, wherein the second impedance is arranged to be substantially equal to the first impedance such that said electrical field between said plasma and said electrode at the surface of said substrate is substantially uniform when said substrate is disposed on said chuck for processing.

9. The plasma processing system as recited in claim 8 wherein said chuck is coupled to said electrode.

10. The plasma processing system as recited in claim 8 wherein said chuck is an electrostatic chuck.

11. The plasma processing system as recited in claim 8 wherein said impedance matching layer is bonded to said edge ring.

12. The plasma processing system as recited in claim 8 wherein said impedance matching layer is bonded to said electrode.

13. The plasma processing system as recited in claim 8 wherein the length and position of said impedance matching layer with respect to said edge ring is adjusted to control said second impedance.

14. The plasma processing system as recited in claim 8 wherein the impedance matching layer is formed from a material with a dielectric constant, wherein said dielectric constant is adjusted to control said second impedance.

15. The plasma processing system as recited in claim 8 wherein the thickness of said impedance matching layer is adjusted to control said second impedance.

16. The plasma processing system as recited in claim 8 wherein said electrode has an outer periphery that is greater than or equal to the outer periphery of said substrate when said substrate is disposed on said chuck for processing.

17. The plasma processing system as recited in claim 8 wherein said electric field produces a uniform sheath voltage at the surface of said substrate when said substrate is disposed on said chuck for processing.

18. The plasma processing system as recited in claim 8 further comprising an RF power source that is coupled to said electrode, said RF power source being configured to supply RF energy to said electrode.

19. The plasma processing system as recited in claim 8 further comprising a heat transfer system for controlling the temperature of said substrate and said edge ring during processing, said heat transfer system including a first channel extending through said electrode to the interface between said chuck and said substrate, and a second channel extending through said electrode to the interface between said electrode and said edge ring, said heat transfer system being configured to provide a heat transfer medium through said channels.

20. The plasma processing system as recited in claim 19 wherein said heat transfer medium is a helium gas.

21. A substrate pedestal for processing a substrate with a plasma, comprising:

an electrode for generating an electric field above said substrate, said electrode having an outer periphery that is larger than an outer periphery of said substrate;

a chuck for holding said substrate during processing, said chuck being disposed on a top surface of said electrode;

an edge ring for shielding said electrode and said chuck from said plasma, said edge ring being disposed above said electrode, said edge ring having a first portion and a second portion, said first portion being configured to surround the edge of said substrate when said substrate is held by said chuck for processing, said second portion being configured to surround the edge of said chuck, wherein said second portion is disposed between said electrode and said substrate during processing; and

an impedance matching layer disposed between said edge ring and said electrode, said impedance matching layer being configured to control an impedance of said electric field through said chuck, said edge ring and said substrate, said impedance being arranged to affect said electric field to improve processing uniformity across the surface of said substrate.

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